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FINAL REPORT
AIR POLLUTION PILOT STUDY
RISK ASSESSMENT METHODOLOGY
AND
MODELING

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This study recommends that nations find solutions for their air pollution problems through cooperative effort.

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NATO/CCMS PILOT STUDY
ON AIR POLLUTION

ASSESSMENT METHODOLOGY AND MODELING

N. 105

F I N A L R E P O R T

Submitted by the Federal Republic of Germany
(Pilot Nation)

Preface

The final report has been prepared by the Pilot Study Working Group for submission to the CCMS. The Pilot Study on Air Pollution Assessment Methodology and Modeling was designed to demonstrate and encourage the practical application of existing knowledge on air quality management systems. The recommendations contained herein are the result of three major activities on

- Air Quality Management Systems
- Assessment Methodology and
- Air Quality Modeling.

The adoption of these recommendations by the Committee on the Challenges of Modern Society will demonstrate that member nations are ready to move toward a dynamic and systematic solution of common air pollution problems.

The results of the study are published in NATO/CCMS documents listed in Appendix A.

The following experts were the members of the Working Group:

Belgium	- Chris De Wispelaere Ministry for Science Policy
Canada	- Michael Kwizak, Environment Canada, Atmospheric Environment Service
Germany	- Erich Weber Ministry of the Interior
France	- Jean Claude Oppeneau Ministère de l'Environnement et du Cadre de Vie
Italy	- Luigi Santomauro Osservatore Meteorologico di Brera
The Netherlands	- Toni Schneider National Institute of Public Health

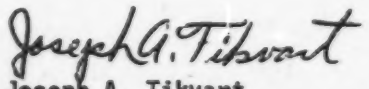
Norway	-	Odd Skogvold Norsk Institutt for Luftforskning
United Kingdom	-	Alistair Keddie Warren Spring Laboratory
United States of America	-	Robert D. Baumann Environmental Protection Agency

The Working Group wishes to express special thanks to the members of both the Assessment Methodology and the Modeling Panel as well as to the members of the special group on Air Quality Management Systems. The Working Group also acknowledges the support of government officials in the cooperating countries.

Respectfully submitted by the pilot and the copilot countries:

Erich Weber, Chairman,
Germany, F. R., Pilot Country

Chris De Wispelaere
Belgium, Copilot Country



Joseph A. Tikvart
United States of America,
Copilot Country

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Resolution

Today protection and enhancement of the environment in which man lives is an important and widely recognized objective. Nevertheless, the implementation of a long-term environmental policy has not become easy. This policy and all its consequences is beset by conflicting interests and opposition. Particularly the possibility of economic recession has increased the sensitivity of nations to environmental policy measures.

It is of decisive importance from the outset for environmental policy that possible future risks must be taken into account as early as now. Thus we must not stop with a description of the present state and the present economic situation. But we must proceed further to give a well-founded forecast of future developments. Therefore, environmental policy needs coordination of economic and other aspects to ensure overall societal stability.

Air pollution has existed for many centuries. However, man's activities now attack the natural fresh air so severely that a pollution control which aims at abatement in several areas of the globe is necessary to prevent a threat to human health, animals, plants and ecosystems. Because of interregional and long-range atmospheric transport many aspects of air pollution have become a global problem. Regional and world wide air pollution has been identified by many national and international monitoring programs.

Efforts have been made in NATO-countries to reduce emissions of specific pollutants from selected source categories. But because of growing industrialization, population and prosperity the quantity and types of air pollution have globally increased.

Additional and coordinated activities to control air pollution are a subject of great concern to NATO-countries, and also are of interest to countries elsewhere in the world.

Based on the availability of those tools for the development of long-term air quality management strategies, be it resolved that member nations:

(1) Accept the need for dynamic efforts to enhance and maintain the quality of the air;
(2) Develop, where appropriate, national air quality management programs, using the systems methodology generated by the CCMS pilot study; and
(3) Encourage cooperation among member countries when air pollution problems are crossing national boundaries.

Recommendations

The following recommendations result from the Pilot Study on Air Pollution Assessment Methodology and Modeling.

The recommendations testify to the desire of member nations to find a solution for their air pollution problems through a vigorous cooperative effort. These recommendations may serve as a further incentive for governments to advance toward their air quality goals.

AIR QUALITY MANAGEMENT SYSTEMS

An important element in the work of both NATO/CCMS air pollution pilot studies has been the development of guidelines for establishing an Air Quality Management System (AQMS). The purpose of an AQMS is to provide a framework for governmental decisions aimed at the prevention of increased air pollution and the nondegradation or improvement of air quality. Such a management system combines several measures with respect to assessment, prediction, legislation, implementation and control effectiveness. It provides several approaches to environmental assessment and the application of control procedures relating to the amount of discharges into the environment.

Several variations in approach are possible in an AQMS, depending on national economic and technological factors, air quality protection policies, and public priorities. Nevertheless the basic concept of an integrated ecosystem approach used by the CCMS/AQMS panel is applicable to all member countries. The systematic AQMS consideration of several factors is a necessity for effective national action in the protection

of air quality. These factors include the adoption of emission standards, ambient air quality objectives, land use planning, and other environmental decision-making. The work of the AQMS panel has demonstrated the applicability and usefulness of its approach to a wide range of national circumstances. Use of the concept in member countries has made a valuable contribution to enhancement of air quality conditions.

Based on the collective experience of the AQMS panel in assessing the effectiveness of an AQMS approach in member countries, it is

RECOMMENDED:

1. That member nations make use of an air quality management system approach in urban and industrial areas where air pollution problems occur or circumstances make an AQMS appropriate. The Air Quality Management Systems described in CCMS Documents No. 71 and No. 71 (revised) are suggested as appropriate models.

2. That member nations review ongoing application of the AQMS approach and identify effective methods for its improvement.

3. That review and revision, if necessary, be made to existing CCMS Air Quality Criteria Documents under the auspices of a NATO/CCMS pilot study.

4. That member nations consider, through the mechanism of a new pilot study, the development of additional criteria documents on the environmental effects of air pollutants. In carrying out this recommendation member nations should take note of the related work done by the World Health Organization.

5. That member nations, through a new CCMS pilot study and in collaboration with the NATO Science Committee, study and assess the multimedia interchange of pollutants, i. e. the impact of air pollutants on the water and the soil.

ASSESSMENT METHODOLOGY

To improve the assessment methodology used by member nations in their air quality control programs, the pilot study investigated and compiled various methods for establishing air pollution emissions inventories and for predicting future emissions. From this work certain basic principles evolved. It is

RECOMMENDED:

6. That air pollution Emissions Inventories employing principles set forth in NATO/CCMS Document No. 104, be established in urban and industrial areas where air pollution problems occur or circumstances make inventories appropriate.

7. That Emissions Projections for urban and industrial areas are conducted as appropriate using the principles described in NATO/CCMS Document No. 100.

8. That member nations further the development of assessment techniques, reference methods and materials, and promote new and better information on air pollutants, as well as the assurance of high quality and compatible data bases. Note should be taken of the methods endorsed by the World Health Organization (WHO), World Meteorological Organization (WMO) and the International Standards Organization (ISO). Member nations may wish to consider the CCMS pilot study mechanism as appropriate for carrying out the international work required in one or more of the above areas.

AIR QUALITY MODELING

The pilot study Modeling Panel has worked on the development of techniques for multiple source air quality modeling. Information about the performance of models used in several countries has been compiled. The experiences of different member nations with different models has been explored through the convocation of model developers and air quality managers.

A practical demonstration of the models under review has been conducted. This demonstration resulted in identification of certain procedures that are fundamental to the successful use of models. From this work example applications of the models were developed. Although considerable progress was made in the field of modeling techniques, further development and validation is required in several particularly important applications.

Based on the work of the Modeling Panel it is

RECOMMENDED:

9. That member nations make use of the procedures and guidance on the application of multiple source air quality models developed in the pilot study and described in NATO/CCMS documents.

10. That member nations consider further international cooperation, through the CCMS pilot study method, in the development of new and advanced modeling techniques in one or more of the following areas:

(a) complex terrain, (b) diffusion of heavy gases which may be toxic or explosive, (c) forecasting of air pollution concentrations under episode conditions, (d) physico-chemical reactions and pollutants sinks, (e) interregional transport of air pollutants up to several hundred kilometers. Included in this work should be the validation and testing of the models considered, and an exchange of experiences, and data bases.

Background

The North Atlantic Treaty Organization (NATO) established the "Committee on the Challenges of Modern Society" (CCMS) at the November 1969 meeting of the North Atlantic Council. The CCMS was charged with developing meaningful environmental and social programs that complement other international programs and with showing leadership, first in solution of existing problems and, second, in development of long-range goals for environmental protection in the NATO sphere of influence and in other countries as well. A first Pilot Study on Air Pollution was initiated by the CCMS at its inaugural meeting in December 1969. The United States (Environmental Protection Agency) has been the pilot nation in the air pollution study, with the Federal Republic of Germany (Federal Ministry of the Interior) and Turkey (Scientific and Technical Research Council) as co-pilot nations.

The Pilot Study on Air Pollution was a program designed to demonstrate and encourage the utilization of existing knowledge for the development of air quality management programs. It entailed the demonstration of a systems approach to air quality management. Case studies have been carried out in Ankara, Turkey; Frankfurt, Federal Republic of Germany; St. Louis, United States of America; Oslo, Norway; South Holland Region, The Netherlands.

The systems approach consists of several major elements, all of which are essential to the objective of optimally enhancing air quality:

(1) designation of area boundary
(2) assessment of air quality
(3) promulgation of criteria
(4) assessment of control technology
(5) establishment of air quality standards
(6) development and implementation of abatement and control strategies.

The methodologies which have been utilized in carrying out the functions of the first four elements of the system have universal application, while the standard setting and implementation elements must be conducted by the states or countries undertaking air quality management programs.

The first Pilot Study on Air Pollution resulted in fifteen recommendations adopted by the Council of the North Atlantic Treaty Organisation on September 11, 1974.

Starting from three of the above recommendations (VI, VII and XIV) the Federal Republic of Germany proposed to initiate a new Pilot Study on Air Pollution Assessment Methodology and Modeling at the CCMS Plenary Session on October 22 and 23, 1974. These NATO/CCMS recommendations were:

1. Recommendation VI stated that member nations should co-operate to develop standardized methods for emissions data storage and retrieval to support requirements in the conduct of national air quality management programs. The U.S. National Emission Data System (NEDS) might serve as a model for a common international system.

2. Recommendation VII stated that member nations should co-operate to develop standardized techniques for projecting emissions and predicting future ambient air quality.

3. Recommendation XIV stated that member nations should agree that the CCMS modeling activity has shown that there is a widespread need for further international co-operation to accomplish the following tasks:

- Bring together model developers and air quality managers for exchange of ideas, discussion of users' needs and demonstration of modeling techniques.

- Standardize modeling techniques for specific air quality management applications and consider how computerized models might be made available for all users.

- Continue to review on-going air quality assessment studies.

Pilot Study on Air Pollution Assessment Methodology and Modeling

In spring 1975 the North Atlantic Council approved the above German proposal. The pilot study work started with the Federal Republic of Germany (Federal Ministry of the Interior) as pilot nation and the United States of America (Environmental Protection Agency) and Belgium (Services du Premier Ministre) as co-pilot nations. The program of work included several major instruments which are essential for air pollution assessment methodology and modeling:

- Emissions Inventory Techniques and Data Handling
- Emissions Projection Techniques
- Principles of Urban Air Quality Modeling
- Comparison of Available Models
- Guidelines for Applications of Models
- Modern Assessment Techniques.

Under the umbrella of a working group, two panels have been operating. Their functions have been as follows:

I Working Group

A. Act as a steering committee for the pilot study and develop a strategy for relating the two expert panels and coordinate their work.

B. Assist in the preparation of the reports and final recommendations to the CCMS and review the documents prepared by the panels.

C. Participate in US-led follow-up activities to the first Pilot Study on Air Pollution.

D. Coordinate with other international activities.

II Assessment Methodology Panel

A. Pursue and carry out recommendations VI and VII of the report on the first pilot study

B. Continue to review present and future assessment studies with respect to the application of assessment methodology

C. Revise and update CCMS Report No. 6, Guidelines to Assessment Methodology, based on results of (A) and (B) above.

III Modeling Panel

A. Pursue and carry out recommendation XIV of the report on the first pilot study

B. Develop standardized models for various air quality management applications.

C. Develop programs to improve modeler/user communications in conjunction with the Assessment Methodology Panel and the Working Group

D. Continue as an information forum on new modeling concepts and techniques.

Under the umbrella of the Modeling Panel of the pilot study, model developers and air quality managers held a series of annual meetings (International Technical Meetings on Air Pollution Modeling and its Application) to exchange ideas, discuss user's needs and demonstrate application techniques. The proceedings of these meetings have been published by the

NATO/CCMS. The aim is to harmonize modeling in the NATO countries and to consider how computerized models might be made available for different users. The meetings mentioned above are a dynamic international forum for evaluating and promoting the routine use of models, their application as well as for information exchange.

The results of the two Assessment Methodology studies on emissions reinforce the concept of utilizing a comprehensive systems approach for air quality management. The six documents on Air Pollution Modeling and its Application provide the scientific basis against which the impact on health and welfare for existing and future conditions can be predicted. The documents on Air Quality Management Systems will allow for the development of control strategies for alleviating the near-term problems as well as projected future needs. The document on Glossary of Terms was compiled in order to provide a harmonized application of terms normally used in reports on air pollution problems.

It has been proven that this study meets specific needs not currently being addressed elsewhere in other international organizations. In 1975 an information document describing the activities of the pilot study was submitted to all international organizations involved in air pollution problems, in order to avoid future overlapping or duplication of work.

Air Quality Management Systems

Although efforts are being made to reduce emissions of particular sources, additional and co-ordinated activities are urgently needed. It is not sufficient to control air pollution by means of isolated actions, control actions have

to be integrated into a co-ordinated system. For this reason a small group of members from the working group have prepared a report on Guidelines to Air Quality Management Systems.

The guideline is addressed to national, regional and local authorities concerned with the establishment and operation of an air quality management system. It gives an overview of several systems, it describes their building blocks as well as the technical and economical requirements and their legal and administrative implications as related to ambient air quality standards and control strategies.

An air quality management system (AQMS) consists of the following items:

- an assessment of present ambient air quality, the pollution emission and related factors
- the comparison of existing air quality levels with standards, criteria and guidelines
- the projection of future emissions and ambient air quality
- the development, implementation and revision of a control strategy.

The AQMS comprises the past history, the present situation and future developments of air quality in the region concerned. In the AQMS the assembled information is used to develop a strategy plan, this plan is implemented, the results are analysed and if necessary, revised after the incorporation of future information.

The AQMS aims to obtain and maintain an acceptable level of ambient air quality. Although emphasis is mostly placed upon human health effects, it includes effects on flora and fauna and the interaction with other environmental media, to obtain a total environmental approach.

The assessment part includes source and emissions inventories, the determination of existing ambient air quality and related factors such as meteorological and atmospheric chemistry data.

Most AQMS are based on emission standards, product standards, or air quality standards or on a combination of two standards or all of them. In the guideline emission standards and the related control technology, equipment standards and product standards are discussed together with air quality standards or objectives.

The economic aspects of an air quality management system are discussed in relation to ambient air monitoring costs, the costs of emission inventories and the costs of modeling.

The strategy plan is the final and most difficult part of an AQMS. Generally speaking the selection of the initial strategy plan should be based on:

- determination of ambient air quality
- determination of the sources of air pollutants
- modeling and projection of air pollution emissions to forecast future air quality
- formulation, implementation and enforcement of air pollution control.

The strategy plan must be reviewed periodically and revised as appropriate. A revision is necessary if the plan is inadequate to obtain the adopted standards or objectives. Also a review of the plan should be made after periods of 3 - 5 years. These reviews will check whether assumptions and boundary conditions applied in the plan design are still valid.

The emphasis in the guideline is put on the formulation and selection of a strategy plan. Therefore major strategy plan options, criteria for the selection of a control strategy for the surveillance technique are described in detail. Also three documents on air pollution emissions inventory systems, air pollution emissions projection and introduction to air quality modeling produced by the two panels of the CCMS air pollution study are added to form an integral part of the report on Guidelines to Air Quality Management Systems.

Assessment Methodology

The Assessment Panel members, belonging to seven NATO countries, have exchanged their views and experiences in the fields of emissions inventory systems and emissions projecting. Two documents have emerged as a result of these exchanges.

The first document consists of an introductory part and a number of technical papers. In the technical papers the emissions inventory systems, as used or as being developed in the NATO countries are described. From these papers it is obvious that large differences exist in the objectives and resources of the different inventory systems and, as a consequence, also large differences in the effectiveness of these

systems. Some countries have extensive inventory systems, while others are only in the process of developing a system or have limited their objectives to inventorying a specific pollutant or to a limited area of the country.

The most significant results of the panel's work are presented in the introductory part of the document. It summarises the objectives of an inventory, and shows how the scope of the inventory is determined. It describes which elements the system may contain, the resolution that can be obtained, how the data can be collected, and processed, and how they should flow through the system.

Perhaps most useful for the reader is the checklist for establishing an emissions inventory system. In this section a number of important suggestions are offered concerning the planning and the concept of the system, as well as about the collection, handling and updating of the data.

The document as a whole, together with the annexes, will be extremely useful to someone who is faced with the task of setting up, organizing and operating either a large or a small system.

The second document is concerned with projecting emissions, an activity that is of utmost importance in the framework of an air quality management system. Since this field is relatively new, only two countries (USA and Germany) have contrib ed a national technical paper. It was possible, however, to write an introductory document which summarises the views of the panel members based on the experiences of several NATO countries. In this document the reasons for and the capabilities of estimating future emissions are discussed. A number of valuable techniques to be used in macro- and micro-forecasting are

offered. After a discussion of responsibilities, the uncertainties of forecasting emissions are also discussed. It appears that for applying the projection techniques to the available emissions inventory data bases, primarily area source data must be forecasted, and individual emitters are only represented by a few aggregated categories in the forecast. The following types of information are required: census and economic data, regulations, control technology, emission factors and local data. Also the form and the contents of the forecasts, the validation of the methodologies and the required resources are briefly mentioned.

Air Quality Modeling

The Modeling Panel has worked on the development and application of multiple source air quality models. Information has been gathered which describes the performance of multiple source Gaussian air quality models used in several NATO countries. The Modeling Panel has brought together the model developers and the air quality managers to consider and evaluate the application of given models to specific problems in the various member nations.

Specifically the Modeling Panel has worked to provide a common NATO effort to:

a) bring together model developers and air quality managers for the exchange of ideas, discussion of user's needs and demonstration of modeling techniques.

b) to standardize modeling techniques for specific air quality management applications and to select candidate computerized models for common application.

c) to review current air quality assessment studies.

The Modeling Panel has been responsible for the development of the following reports.

1. Introduction to Air Quality Modeling

2. Fundamentals for the Application of a Gaussian Plume Model

3. Practical Demonstration of Multiple Source Urban Air Quality Modeling

4. Uses and Needs for Air Quality Modeling

5. Bibliography of Grey Literature on Applied Air Quality Modeling

6. Bibliography of Grey Literature on New Modeling Techniques

7. Proceedings of the 6th, 7th, 8th, 9th and 10th International Technical Meetings on Air Pollution Modeling and its Application.

The first document introduces to the aims of air quality models, i. e. the fundamental problem of calculating pollutant concentrations in the environment due to one or several emitting sources. This document reviews methods used and problems encountered when modeling air pollution.

The document on fundamentals of the application of a Gaussian plume model shall give information on the capabilities, applicability and limitations of one special model to calculate air quality, the Gaussian plume model.

The paper on the practical demonstration of Multiple Source Urban Air Quality Models summarizes the characteristics of the models involved in this comparative examination and the results of the model calculations.

The document on uses and needs for air quality modeling intends to document the status and current uses of air quality simulation models, problems encountered in their application and the requirement for the models.

The fifth and sixth document on grey literature intends to give a summary of literature on applied (mainly Gaussian plume) models and new models in form of a bibliography. It shall help the modeler or user to trace literature on several subjects of modeling via descriptors.

As a result of these publications and through active participation in the International Technical Meetings, the Modeling Panel has been successful in promoting a common NATO basis for dealing with air quality management problems using common modeling techniques. Evidence of the success of these efforts has been present in all of the International Technical meetings.

Glossary of Terms

The compilation of a Glossary of Terms was not planned initially. But when the first drafts of the national contributions to Air Pollution Emissions Inventory as well as of the document about the practical demonstration of Multiple Source Urban Air Quality Models (Gaussian Plume) were written the panel members noticed that varying English terms for expressing certain subjects were in use in the different cooperating countries. Sometimes, discussions about technical and scientific items among the experts ended by their realizing that language differences were the reasons for the discussion but not basic scientific divergencies.

The present glossary particularly lists and explains terms which are contained in the documents of the air pollution pilot study. They are used in the Air Quality Management System document as well as in all assessment methodology and modeling documents. The explanations were partially taken from already existing glossaries - they are quoted on one of the first pages of the document - partially they were worked out by the panel members.

Proposed Follow-Up Activities

The follow-up activities on the recommendations of the pilot study on Air Pollution Assessment Methodology and Modeling concentrate on recommendations 1, 2, 6, 7, 8, 9 and 10 (pages 3 - 7 above). These recommendations apply to the further exchange of information on the application of the methods and techniques which are described in the 14 NATO/CCMS technical documents published during the current pilot study.

The follow-up activities will consist of:

(a) AQMS - Workshops in which the experiences in the participating NATO countries with the application of the air quality management systems approach will be discussed.

(b) International Technical Meetings on Air Quality Modeling and its Application to bring together developers and users of air quality models to discuss issues of common interest.

A. AQMS-Workshops

Workshops to discuss experiences in the application of the AQMS approach in the participating NATO member countries will be held in five consecutive years (1980 through 1984). They will provide a comprehensive review of the following aspects of AQMS:

- Air Quality Management Systems
- Emissions
- Ambient Air Quality and Deposition
- Emissions Projection and Air Quality Simulation
- Strategy Plans

Each year, one or more subjects applying to one aspect will be discussed. For each workshop, participating countries will be invited to present papers. The results of the discussion at the workshops including the papers will be reported to the CCMS and then published.

About 20 experts from the NATO member countries who co-operated in the pilot study will participate in the follow-up workshops.

The program for the workshops has been drafted as follows:

1980 Air Quality Management Systems

1981 Emissions

- standards (incl. product standards)
- monitoring
- inventories
- legal basis
- costs
- emission factors

1982 Ambient Air Quality and Deposition

- standards
- monitoring
- inventories
- legal basis
- costs
- applications/experiences

1983 Emissions Projection and Air Quality Simulation

- standardization
- legal basis

- meteorological data needs
- emission data needs
- costs
- applications/experiences

1984 Strategy Plans
with respect to

- substances
- emitters/emitter categories
- area specification (nationwide, regional, local)

B. International Technical Meetings on Air Quality Modeling and its Application (ITM)

In the past, the ITM was a forum for the presentation of scientific findings on modeling as well as for an exchange of views and experiences between users and developers of air pollution models.

In the future the ITM will follow this tradition and bring together experts to discuss applications of existing models. Also the development of new models, including model validation, model evaluation, data input requirements should be topics on the agenda of the ITM, as well as national reports on the application and development of air quality models.

Within the framework of the CCMS the ITM in the past had also established contact with experts from nations who are not members of the North Atlantic Alliance and who, nevertheless, in part permanently participated in the ITM meetings and provided valuable contributions. This tradition should be continued and strengthened.

C. Organization

Preparatory work and elaboration of the reports on results achieved by the Workshop and the ITM are continuing by the Federal Republic as the pilot nation and Belgium as the co-pilot nation in the same spirit of good cooperation which proved to be so successful during the pilot study. It was agreed that the Federal Republic of Germany should assume responsibility for organization of and reporting on the Workshops, and Belgium for the ITM.

ANNEX I

Names and Addresses of Panel Members (as of Fall 1978)

R. D. Bauman	Environmental Protection Agency (OAQPS - SASD - ESB - MD - 12) Research Triangle Park USA - 27711 North Carolina
A. Berger	Institut d'Astronomie et de Géophysique Université Catholique de Louvain 2, Chemin du Cyclotron B - 1348 Louvain la Neuve
A. Braig	Battelle Institut Am Römerhof 35 D-6000 Frankfurt 90
P. J. Choquette	Air Pollution Control Directorate Environment Canada Cdn - Ottawa, Ont. K I A IC8
R. Dams	University of Gent Institute Nuclear Sciences Proeftuinstraat 86 B - Gent 9000
C. De Wispelaere	Diensten voor Programmatie van het Wetenschapsbeleid Wetenschapsstraat 8 1040 Brussel
J. Frank	Rheinisch-Westfälischer TÜV Steubenstraße 53 D - 4300 Essen
F. Gerold	TÜV Rheinland Postfach 10 17 50 D - 5000 Köln 1
B. Gutsche	Institut für Geophys. Wissenschaften Freie Universität Thielallee 50 D - 1000 Berlin 33
K. E. Joerss	Umweltbundesamt Bismarckplatz 1 D - 1000 Berlin 33
D. Jost	Umweltbundesamt Bismarckplatz 1 D - 1000 Berlin 33

W. Klug	TH Darmstadt Institut für Meteorologie Hochschulstraße 1 D - 6100 Darmstadt
L. Kropp	TÜV Rheinland Postfach 10 17 50 D - 5000 Köln 1
M. Kwizak	Air Quality and Inter-Environmental Research Branch 4905 Dufferin St. Atmospheric Environment Service Cdn - Downsview (Toronto) Ont. M 3 H 5 T 4
E. Lahmann	Bundesgesundheitsamt Corrensplatz 1 D - 1000 Berlin 33
L. E. Niemeyer	Environmental Protection Agency ESRL (MD-80) Research Triangle Park North Carolina 27711 USA
H. Meinl	Dornier System Postfach D - 7990 Friedrichshafen
C. Morawa	Umweltbundesamt Bismarckplatz 1 D - 1000 Berlin 33
F. Nieuwstadt	Koninklijk Nederlands Meteorologisch Instituut Utrechtseweg 297 NL - De Bilt 2664
J. C. Oppeneau	Ministere de la Culture et de l'Environnement Service d'Affaires Scientifiques 14 Bvd. du Général Leclerc F - 92521 Neuilly/Seine
B. Reilhac	Ministere de la Culture et de l'Environnement Secretariat d'Etat a l'Environnement 14 Bvd. du Général Leclerc F - 92521 Neuilly/Seine
L. Santomauro	Osservatorio Meteorologico Brera Via Brera 28 I - 20121 Milano

T. Schneider	RIJKS Institut voor de Volksgesondheit P. O. Box 1 NL - Bilthoven
B. Sivertsen	Norwegian Institute for Air Research P. O. Box 130 (NILU) N - 2001 Lilleström
O. Skogvold	Norwegian Institute for Air Research P. O. Box 130 (NILU) N - 2001 Lilleström
J. Tikvart	Environmental Protection Agency (OAQPS - MDAD + DM + 14) Research Triangle Park USA 27711 North Carolina
H. E. Turner	Air Quality and Inter-Environmental Research Branch 4905 Dufferin St. Atmospheric Environment Service Cdn - Downsview (Toronto) Ont. M 3 H 5 T 4
V. Vent-Schmidt	Deutscher Wetterdienst Frankfurter Str. 135 D - 6050 Offenbach
L. H. J. Wachters	BM - TNO P. O. Box 541 NL - Apeldoorn
E. Weber	Bundesministerium des Innern Graurheindorfer Str. 198 D - 5300 Bonn 7
M. L. Williams	Warren Spring Laboratory P. O. Box 20 Gunnels Wood Road GB - Stevenage Hertfordshire SG 1 2 BX

ANNEX II

NATO/CCMS Documents on the First Air Pollution Pilot Study (available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

AIR POLLUTION (No. 5)

Proceedings of the 2nd Meeting of the Expert Panel on Air Pollution Modeling, (26 - 27 July 1971, Paris, France). Out of stock

AIR POLLUTION (No. 6)

Guidelines to Assessment of Air Quality (Revised)

APPENDIX A	Assessment of Air Quality in Ankara (February 1973)
APPENDIX B	Assessment of Air Quality in St. Louis (February 1973)
APPENDIX C	Assessment of Air Quality in Frankfurt (June 1974)
APPENDIX D	Assessment of Air Quality in Oslo (February 1973)
APPENDIX E	Assessment of Air Quality in the South Holland Region (December 1973)

AIR POLLUTION (No. 7)

Quality Criteria for Sulphur Oxides (November 1971). Out of stock

AIR POLLUTION (No. 8)

Air Quality Criteria for Particulate Matter (November 1971). Out of stock

AIR POLLUTION (No. 10)

Air Quality Criteria for Carbon Monoxide (June 1972)

AIR POLLUTION (No. 12)

Control Techniques for Sulphur Oxide Air Pollutants (October 1973)

AIR POLLUTION (No. 13)

Control Techniques for Particulate Air Pollutants (October 1973)

AIR POLLUTION (No. 14)

Proceedings of the 3rd Meeting of the Expert Panel on Air Pollution Modeling
'2 - 3 October, 1972, Paris)

AIR POLLUTION (No. 15)

Air Quality Criteria for Nitrogen Oxides (June 1973)

AIR POLLUTION (No. 18)

Control Techniques for Carbon Monoxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 19)

Control Techniques for Hydrocarbon and Organic Solvent Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 20)

Control Techniques for Nitrogen Oxide Emissions from Stationary Sources (October 1973)

AIR POLLUTION (No. 29)

Air Quality Criteria for Photochemical Oxidants and Related Hydrocarbons (February 1974)

AIR POLLUTION (No. 30)

Proceedings of the 4th Meeting of the Expert Panel on Air Pollution Modeling, (28 - 30 May 1973, Oberursel, Germany)

AIR POLLUTION (No. 33)

Final Report (May 1974)

AIR POLLUTION (No. 35)

Proceedings of the 5th Meeting of the Expert Panel on Air Pollution Modeling (4 - 6 June 1974, Roskilde, Denmark)

AIR POLLUTION (No. 41)

First Follow-up Report (December 1975)

AIR POLLUTION (No. 50)

Second Follow-up Report (December 1976)

AIR POLLUTION (No. 67)

Third Follow-up Report (November 1977)

AIR POLLUTION (No. 96)

Fourth Follow-up Report (October 1978)

AIR POLLUTION (No. 6, Appendix C revised)

Assessment of Air Quality in Frankfurt (December 1977)

ANNEX III

NATO/CCMS Documents on the Pilot Study on Air Pollution Assessment Methodology and Modeling
(available at: NATO/Committee on the Challenges of Modern Society, NATO Headquarters, Brussels, Belgium)

Air Pollution (No. 42)

Proceedings of the 6th International Technical Meeting on Air Pollution Modeling and its Application
(24 - 26 September 1975, Frankfurt/Main, Germany)

Air Pollution (No. 51)

Proceedings of the 7th International Technical Meeting on Air Pollution Modeling and its Application
(7 - 10 September 1976, Airlie House, USA)

Air Pollution (No. 70)

Bibliography on Grey Literature on Air Quality Modeling, Part I (Applied Models) (October 1977)

Air Pollution (No. 71)

Air Quality Management Systems (AQMS) (October 1977)

Air Pollution (No. 88)

Bibliography on Grey Literature on Air Quality Modeling, Part II (New Modeling Techniques) (October 1978)

Air Pollution (No. 89)

Glossary of Terms Generally Used in Air Pollution Assessment Methodology and Modeling (October 1978)

Air Pollution (No. 80)

Proceedings of the 8th International Technical Meeting on Air Pollution Modeling and its Application
(20 - 23 September 1977, Louvain-la-Neuve, Belgium)

Air Pollution (No. 99)

Introduction to Air Quality Modeling (October 1978)

Air Pollution (No. 100)

Air Pollution Emissions Projecting (October 1978)

Air Pollution (No. 101)

Uses and Needs for Air Quality Modeling (May 1979)

Air Pollution (No. 102)

Fundamentals for the Application of a Gaussian Plume Model (April 1979)

Air Pollution (No. 104)

Air Pollution Emissions Inventory Systems
(October 1978/July 1979)

APPENDIX A: Emissions Inventory in Belgium
APPENDIX B: Emissions Inventory in Canada
APPENDIX C: Emissions Inventory in Germany, Federal Republic of
APPENDIX D: Emissions Inventory in The Netherlands
APPENDIX E: Emissions Inventory in Norway
APPENDIX F: Emissions Inventory in the United States of America

Air Pollution (No. 106)

Practical Demonstration of Multiple Source Urban Air Quality Modeling (Gaussian Plume) (August 1979)

Air Pollution (No. 71, Revised)

Air Quality Management Systems (AQMS) (April 1979)

Air Pollution (No. 105)

FINAL REPORT (October 1979)

Air Pollution (No. 103)

Proceedings of the 9th International Technical Meeting on Air Pollution Modeling and its Application
(28 - 31 August, 1978, Toronto, Canada)

Air Pollution (No. 108)

Proceedings of the 10th International Technical Meeting on Air Pollution Modeling and its Application
(23 - 26 October, 1979, Roma, Italy)

ANNEX IV

LIST OF THE MEETINGS OF THE WORKING GROUP AND THE PANELS

Inaugural meeting:		March 26/27, 1975, Cologne, Germany
2. Meeting	:	Sept. 29 - Oct. 1, 1975, Meersburg, Germany
3. Meeting	:	March 29 - 31, 1976, Venice, Italy
4. Meeting	:	Sept. 13 - 15, 1976, Quail Roost, USA
5. Meeting	:	April 4 - 7, 1977, Apeldoorn, Netherlands
6. Meeting	:	Sept. 14 - 16, 1977, Louvain-la-Neuve, Belgium
7. Meeting	:	April 3 - 6, 1978, Bandol, France
8. Meeting	:	Aug. 22 - 25, 1978, Toronto, Canada
9. Meeting	:	March 21 - 23, 1979, Florence, Italy

INTERNATIONAL TECHNICAL MEETINGS ON
AIR POLLUTION MODELING AND ITS APPLICATION (ITM)

6.	ITM :	Sept.	24 - 26, 1975, Frankfurt/M., Germany
7.	ITM :	Sept.	7 - 10, 1976, Airlie House, USA
8.	ITM :	Sept.	20 - 23, 1977, Louvain-la-Neuve, Belgium
9.	ITM :	Aug.	28 - 31, 1978, Toronto, Canada
10.	ITM :	Oct.	23 - 26, 1979, Rome, Italy